

Thesis/
Reports
Leonard,
R. E.

backcountry
research
program

U.S. Forest Service - Durham, N H

backcountry
research
program

A REPORT ON PROJECT DIRECTION
AND RESEARCH STUDIES

PREPARED BY
THE BACKCOUNTRY RESEARCH PROJECT
USDA FOREST SERVICE
P.O. BOX 640
DURHAM, NH

FALL 1979

Preface

The Backcountry Research Project of the U. S. Forest Service, Northeastern Forest Experiment Station, at Durham, N.H., receives many requests from researchers, students and casually interested citizens for information about backcountry recreation problems and/or the types of research studies conducted by the project. In order to respond more quickly to these requests we have put together a report which summarizes the project's research objectives and the system under which our studies are organized.

The major research studies are briefly described with technical details omitted. Abstracts of all the studies conducted since 1976 are included at the end of the report. For persons interested in specific studies, a publications list is also provided. The abstracts and publications list will be updated annually.

Further information about the program or specific studies may be obtained by writing:

Raymond E. Leonard, Project Leader
Backcountry Recreation Research Project
U. S. Dep. Agriculture, Forest Service
Forestry Sciences Laboratory
P.O. Box 640
Durham, N. H. 03824

TABLE OF CONTENTS

	<u>Page No.</u>
INTRODUCTION	1
BACKCOUNTRY RESEARCH PROGRAM	2
Physical Resource Constraints	7
Management Resource Constraints	11
Social Constraints	22
APPENDIX	24-61
Publications List	24-26
Study Abstracts	27-61

INTRODUCTION

Prior to the 1960's, the principal demand for northeastern forest lands was for the production of timber. Today, with increased leisure time and better highways, the recreational benefits of the forests are in higher demand. The remote, undeveloped areas of the forests are especially desired for 'backcountry recreation.'. Visitors to the backcountry are referred to as "dispersed recreationists" to distinguish them from developed roadside campground visitors. Dispersed recreation activities include backpacking, cross-country skiing, trailbike riding, and hunting.

Much of the attraction to backcountry forest lands is due to their locations. Many of the areas lie in mountainous regions where high peaks above treeline offer wide vistas of undeveloped land. Clear streams and ponds remain unpolluted by man. Large contiguous areas of forest offer space and tranquility not found in today's metropolitan areas.

The environments of these lands tend to be more sensitive to human impacts than in the flatter, low-lying plains and river valleys. Climatic conditions are often harsher, slopes are steeper, and soils are more shallow. In alpine zones, plant life clings tenuously to the ground in places sheltered from the wind where soil has accumulated.

When large numbers of recreationists visit these lands, several undesirable environmental responses may occur. Mountain trails may erode into gulleys which then favor even more rapid soil erosion. Alpine areas may be so heavily trampled that the vegetation cannot recover. Some overnight sites may become so crowded that the volume of human waste left behind cannot be handled by the shallow soils.

BACKCOUNTRY RESEARCH PROGRAM

In 1976, the U. S. Dep. Agriculture, Forest Service, Northeastern Forest Experiment Station, established the Backcountry Research Program for the Eastern United States at Durham, New Hampshire. The research unit was set up to identify and study the problems that have occurred in the backcountry since the recent increase in use.

The program has been conducting studies to meet the following objectives:

1. Determine the physical impacts of dispersed recreationists on remote forest ecosystems, and
2. develop management systems that can provide compatibility between the recreationists and the ecosystems.

Concurrently, the program is developing design/planning guidelines for dispersed recreation areas of the Eastern United States. These guidelines will emphasize ways to prevent physical/biological degradation of remote and/or fragile ecosystems.

Forest managers want to know how many people can use a site before resource damage becomes irreversible. The optimum number of people for a particular site will depend on several factors. For example, a mountain site located at an elevation of 3800 feet in a softwood forest over shallow, sandy-clay loams (less than 2 feet deep) has some physical limitations for absorbing the sewage and trampling from hikers and campers. If the forest manager wanted to provide a primitive, quiet location for only a few overnight visitors per night, the site could accommodate this use with little management attention.

However, if the manager desired to use this site to accommodate about 5 to 15 persons per night, the site would require increased management attention and money. Human waste would have to be disposed of with a non-leaching system, such as composting. The construction of a shelter or several tent platforms would be needed to minimize groundcover damage and soil erosion. A full-time caretaker might be needed to regulate the site use and to caution hikers about the fragility of the area. The trail to the site would require a moderate amount of erosion protection.

If the site were chosen to accommodate very heavy visitor use, such as 30 to 40 persons per night, it could be structured to do so. A large hut or several shelters would be needed, and an elaborate human waste disposal system would be needed to either remove the waste from the site or compost it at the site. Trails to the site would require significant "hardening" to prevent erosion, and several personnel would probably be needed to regulate and assist visitors at the site. The cost would be high and the character of the site would be quite different from the original natural condition.

In summary, most backcountry areas have the potential to accommodate different levels of use. The final selection of a site capacity should be left to the manager who must match the recreational objectives for an area with the facilities and maintenance time and money required to prevent resource damage. However, there may be a limit to the amount of time and money a forest manager can spend on a particular overnight site. There may also be a limit to the kind of manmade structures that some hikers will find acceptable in the backcountry. One of these constraints may set a limit on the compatible site use level. This limit would establish what we have called a "design capacity" for the site.

In general, then, backcountry design capacities depend on the interaction of three major factors:

- (1) The physical resource limitations, or constraints, of the land to support recreational use;
- (2) the available management techniques and money to provide facilities and prevent resource degradation; and
- (3) the social constraints imposed by the recreationists' desires and expectations for their backcountry trip.

The Backcountry Research Program is attempting to determine the necessary facilities and the costs that will be required to accommodate different visitor levels on different physical land types. With this information, managers should be in a better position to make backcountry planning decisions.

RESEARCH ACTIVITY

All of the program's research studies fall within the framework of the "design capacity" system (Fig. 1). About half of the studies are directed toward learning the types and intensities of physical impacts made by backcountry recreationists on different land types. Most of the other studies are evaluations of methods that managers can use to alter either (1) the physical durabilities of backcountry sites for recreational use or (2) visitor use patterns. Social research on visitors' desires and expectations is being conducted by Forest Service research units in the West. The Durham research program does not plan to add many research studies of this type to the existing program.

An abstract of each of the program's research studies is provided at the end of this report. The study number, shown at the top of the abstract, also appears on the design capacity chart, adjacent to the research problem area (box) to which the study belongs. Many of the studies have been, or continue to be, conducted by researchers at universities through cooperative agreements. These are indicated on the abstracts with a "C" by the study number. Abstracts of completed studies contain a summary of the results. Ongoing studies show no results. A brief discussion of the program's major studies is presented on the following pages.

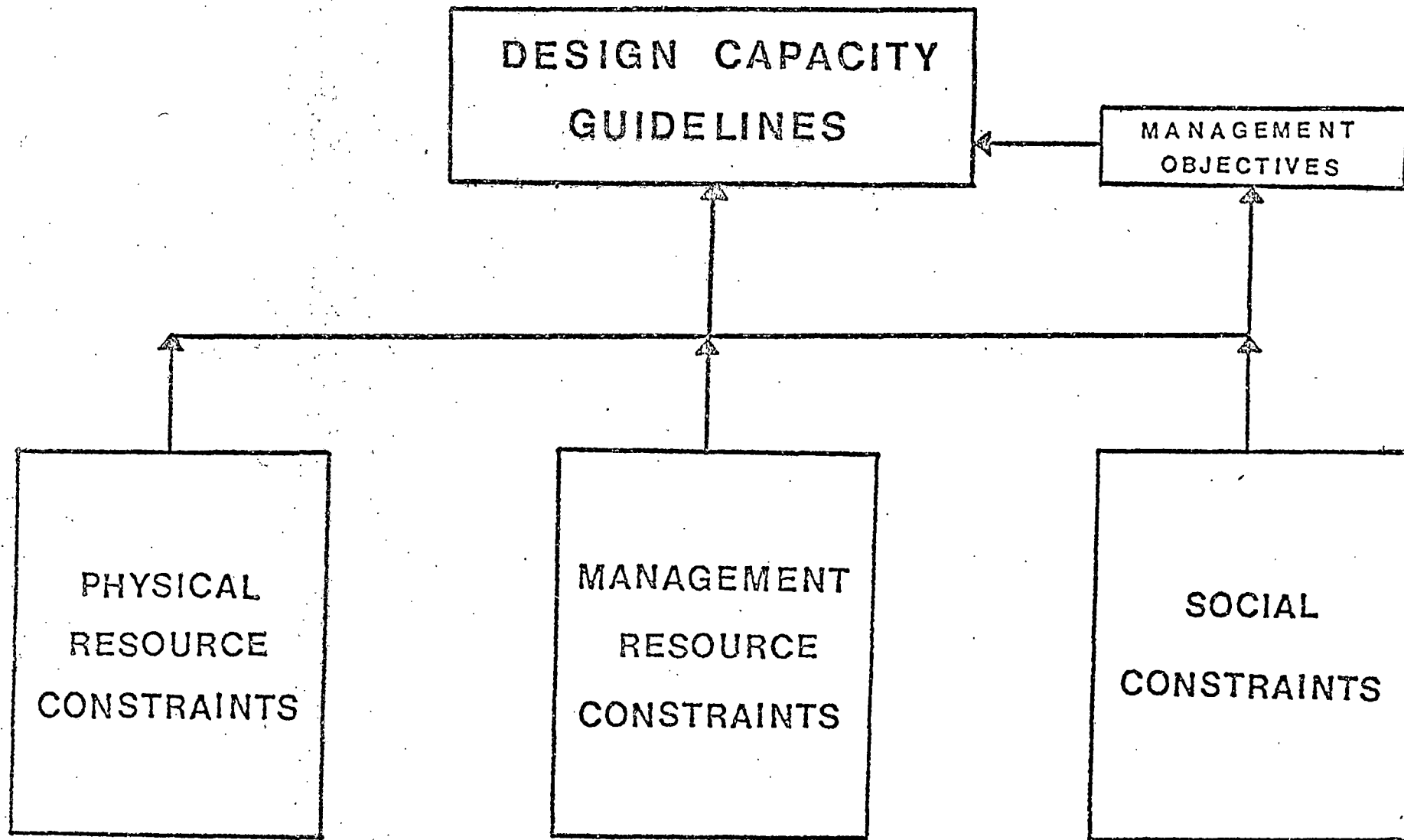


Figure 1. Factors affecting site capacities.

Physical Resource Constraints

In order to understand the physical resource constraints of remote ecosystems for backcountry recreation, studies of the baseline conditions of environments as well as measurements of changes in the physical conditions are being conducted (Fig. 2). Examples of this research are:

Trail Erosion. In order to analyze hiking impacts to trails, a transect method was developed in 1975 to measure soil loss, trail widening and vegetative changes across a trail. The transect method establishes a series of trail cross-sectional areas (transects), which are located to reflect a variety of physical conditions found along the trail. At each transect, trail width and depth are measured from a fixed tapemeasure stretched across the trail between two trees. The tape can be accurately repositioned at a later date from two permanently fixed tree tags (Fig. 3).

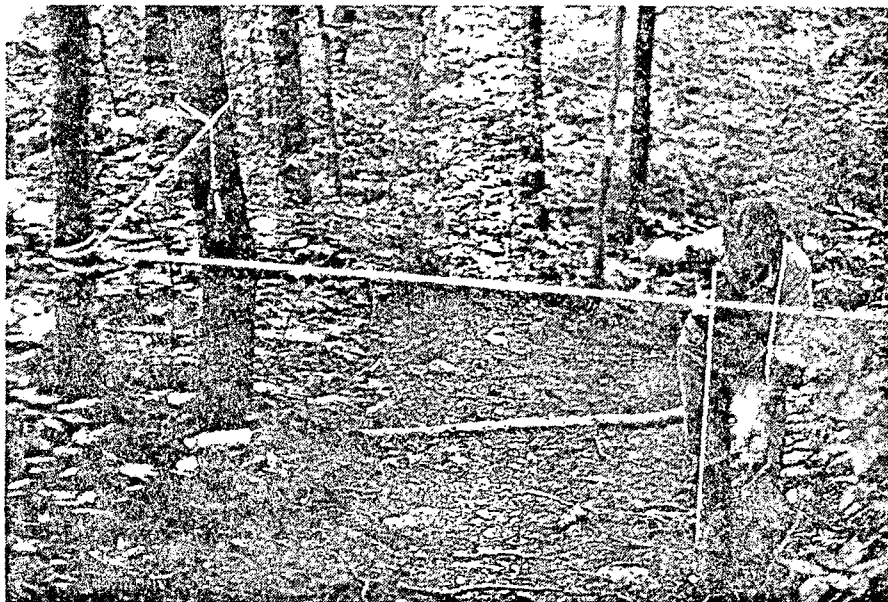
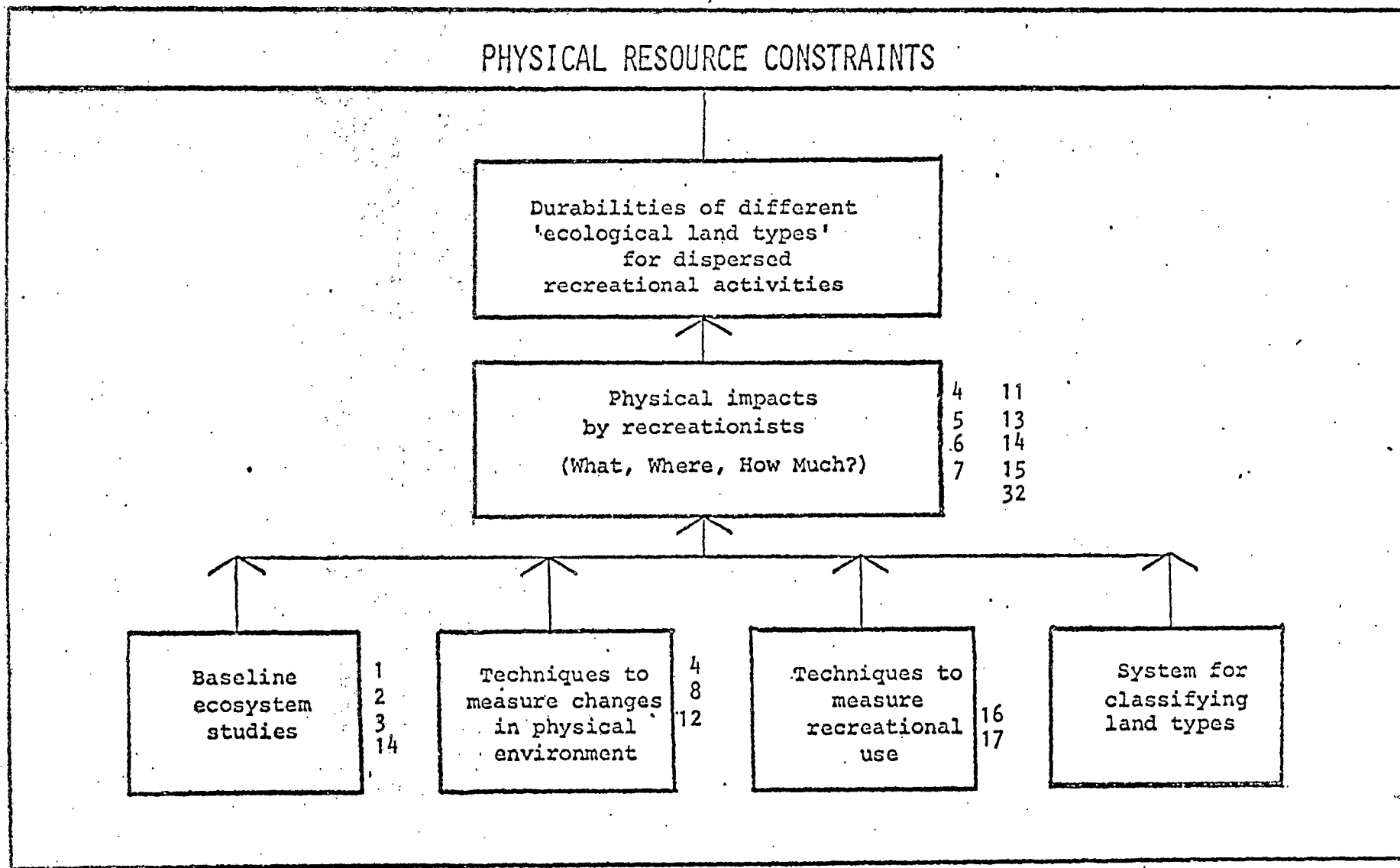


Fig. 3--A researcher measures the distance between a fixed tape and the trail surface at ten-centimeter intervals. Surface soil condition and vegetation occurring along the transect are also recorded.

Figure 2. Research areas within physical resource constraints.



The transect data has provided the first documentation of trail conditions for three different trails in the New England mountains. Rates of trail erosion are being determined and plotted with the aid of computer techniques. These erosion rates are being compared to the soil and geomorphological characteristics of the area to determine which conditions are most sensitive to hiking use.

Subalpine Bogs. Many hiking trails pass through subalpine bog areas. These areas are characterized by very wet, acidic, and nutrient-deficient soils which support only sphagnum moss, sedges, and dwarf heath shrubs. A characterization of these areas was made in order to have some standard by which to measure changes in the area. Where hiking trails pass through bogs, vegetative cover on and near the trails cannot survive the compaction from foot traffic. Also, the species composition of the vegetation adjacent to the trails has been found to change. Bridging the trails with log planks reduces the area of plant loss and provides a drier hiking path.

Trampling Study. A study to learn how many hikers can pass over unused forest ground before trail hardening techniques are needed was started in 1978. Sites at two different mountain elevations having different forest types are being trampled and monitored at weekly intervals. The physical changes of plant species destruction and organic soil layer removal are being observed throughout the season (Figs. 4 and 5).



Fig. 4--A specific number of passes are made on each trampling site to simulate high and low use levels. The results are monitored through photographic and observational methods.



Fig. 5--The "quadrapod" holds the camera so it can be accurately repositioned at each photographic session.

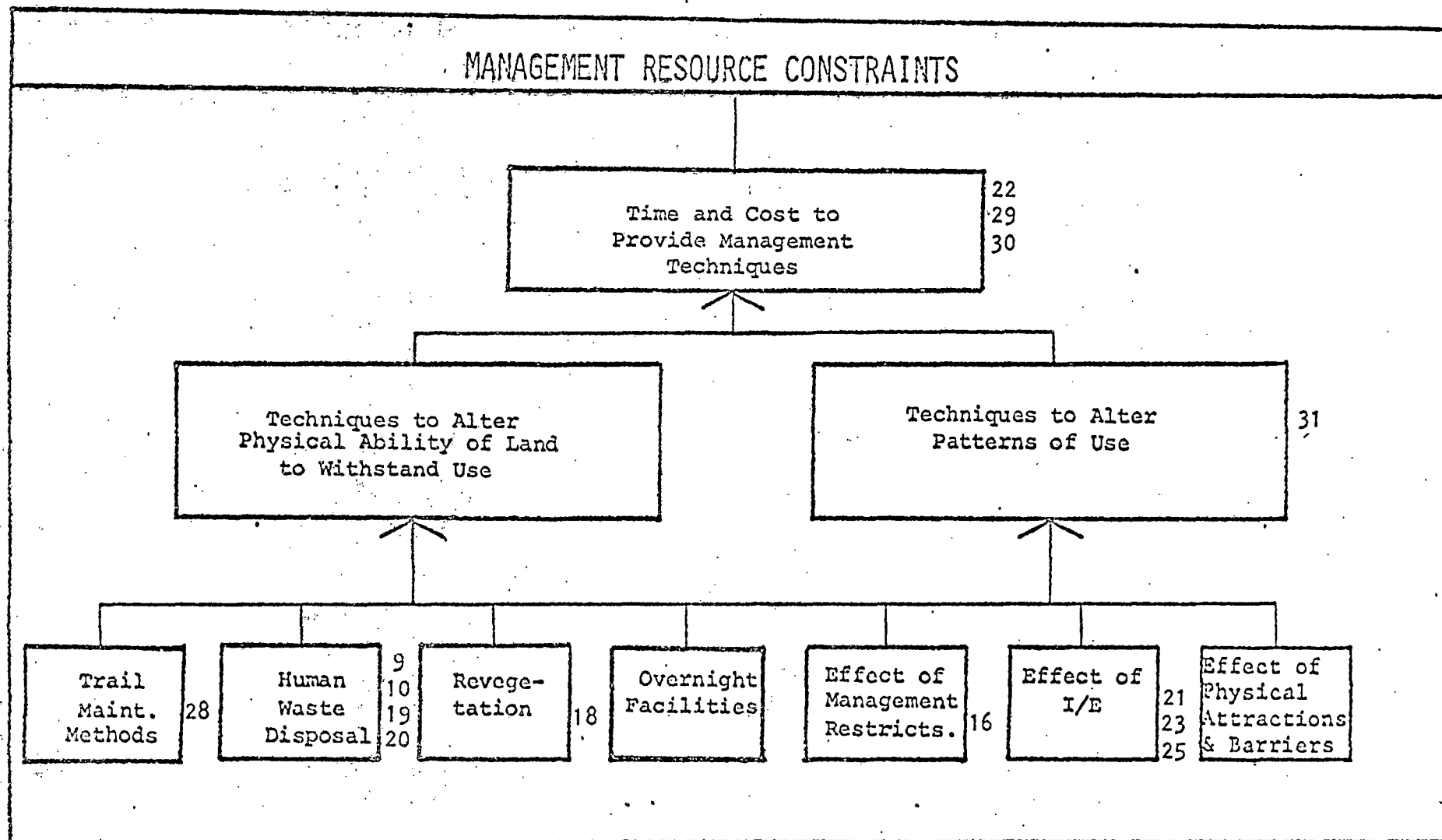
Management Resource Constraints

There are three categories of management resource constraints. They are constraints imposed on management due to financial limitations, constraints due to personnel limitations, and constraints due to knowledge limitations. The Backcountry Research Program is not in a position to affect management's financial or personnel limitations. But we can make contributions toward decreasing the constraints imposed on management due to knowledge limitations. Therefore, we have concentrated our efforts on developing techniques to improve management's knowledge. This research has been divided into two general areas. These are, techniques to alter the physical ability of the land to withstand recreational use, and techniques to alter patterns of use (Fig. 6).

Techniques that can alter the physical durabilities of a backcountry site include trail maintenance methods, human waste disposal methods, revegetation, and overnight facility design and location.

Human Waste Composting. Disposal of human waste has been one of the most critical problems for backcountry managers. Many overnight areas were built at high elevations where the soil is often less than 25 inches deep. These conditions were not limiting in the 1930's when only one to two visitors per night used the facilities. Today, these same areas now receive an average of 10 to 20 visitors per night. Relocation of the privies has been only a short-term solution to the problem because the number of possible privy sites is very limited. The soil beneath the privy must be at least four to five feet deep.

Figure 6. Research areas within management resource constraints.



The research program has been working on waste composting methods. A simple Bin Composter was developed to compost privy wastes mixed with ground bark in a closed container. The decomposition process takes about two weeks and the compost pile reaches temperatures above 60°C. The cost of the unit is about \$100. It can be maintained easily by regular field crews, and the end product is a humuslike substance, free of pathogens and odor. Our experience indicates that one bin used with a privy can process the waste of over 1,500 people per year at a cost of about \$250 each season (Figs. 7 and 8).



Fig. 7--The bin composter provides a safe alternative to the pit privy in areas with shallow or poorly drained soils. Ground hardwood bark and privy wastes are combined and mixed periodically. The result - an odorless, pathogen-free humus.

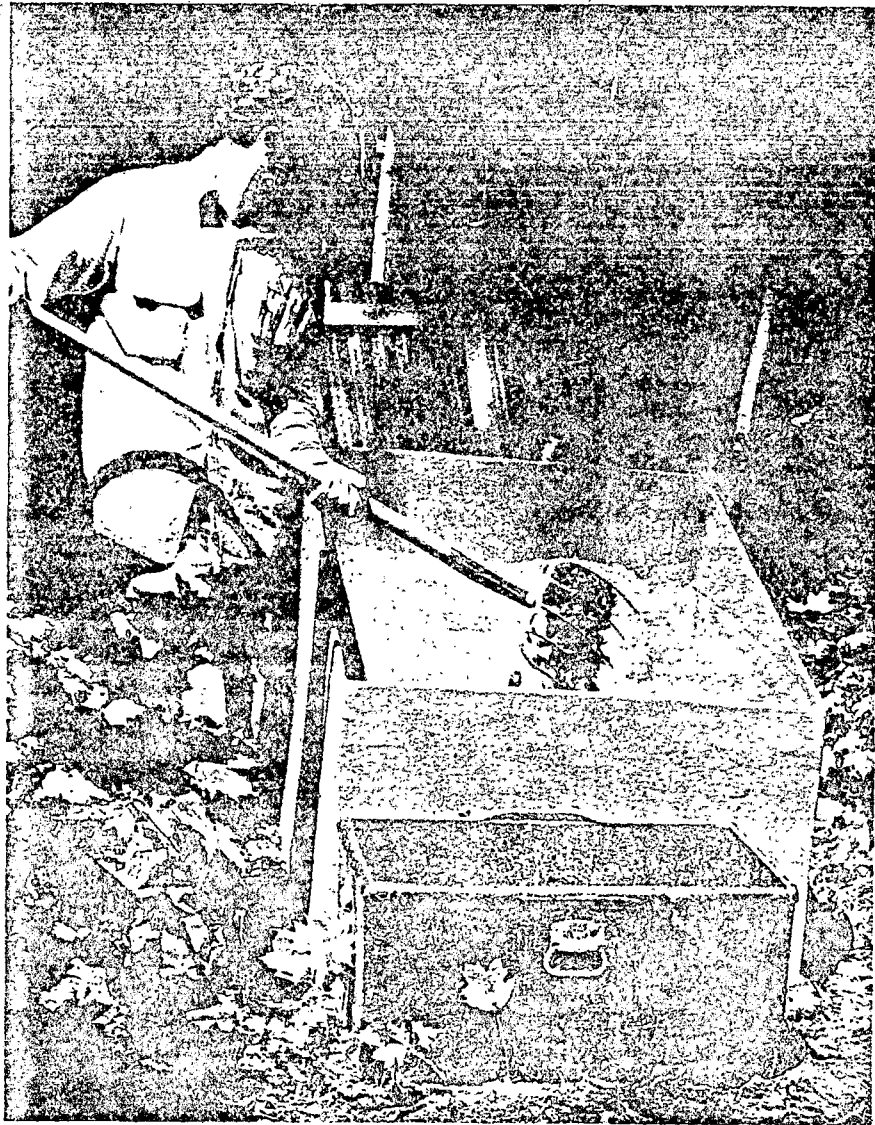


Fig. 8--Mixing is required to expose all parts of pile to lethal temperatures and to provide oxygen (in addition to the vents) needed for aerobic composting.

There are several human waste disposal methods now available to backcountry managers. The pit privy is still feasible for low-elevation sites having deep, well-drained soils. At some heavily used, high-elevation mountain sites, human waste is being flown out by helicopter in 55-gallon metal drums. This method is effective, but quite expensive. A large-volume composting method might prove more satisfactory.

Revegetation and Fertilization. Many summits in the East which support alpine vegetation are popular hiking destinations. Moderate foot traffic can easily damage fragile plant life. Fertilization of alpine and subalpine areas has been attempted to stabilize alpine plants near denuded areas. On the summit of Camel's Hump, Vermont, the major plant species responded favorably to three years of fertilization treatments, while a few species were not affected. However, the species composition of the fertilized plant communities fluctuated in a manner similar to the unfertilized areas, indicating that fertilization of undamaged areas is not harmful, and may be beneficial in the short run.

An attempt to transplant alpine plants into heavily used summit areas has proved unsuccessful. More elaborate methods would be needed to make this technique for increasing ground vegetation feasible. More positive results have been found using fertilizer and grass seed (red fescue and Kentucky bluegrass) on barren stretches of mountain ridges in the Adirondacks.

The second general area under improving knowledge involves techniques to alter visitor use patterns. From a three-year study of hikers on the Long Trail in Vermont, use of the trail and overnight sites was found to cluster around certain popular places, particularly the highest mountain peaks and scenic ponds. At some sites, most of the overnight shelter use occurred during only 15 percent of the summer season, which crowded the sites during a few days of the season, and left the sites empty during the rest of the season. Similar patterns have been reported to exist at Western backcountry areas as well.

Managers cannot afford to "harden" all sites for very heavy but infrequent use. Nor would this be a desirable way to treat all backcountry facilities. The provision of different backcountry opportunities, some offering low density use or solitude and some offering more crowded but convenient facilities, is an oft-stated management objective of public forest lands. In order to provide for more backcountry visitors, managers will need to encourage people to disperse from the well-used sites.

Three possible ways to influence visitor use patterns are being studied. These are, the use of management restrictions; the use of information and education; and the use of physical attractions and barriers. Examples of these kinds of studies are discussed on the following pages.

Wilderness Permits. In 1975 and 1976, mandatory Wilderness permits, a means of management restriction, were found to be very effective in limiting the number of overnight users to a well-defined, well-patrolled Wilderness Area. The permit was of limited value, however, in affecting the hikers' camping locations. Instructions to disperse and camp at least 200 feet off the trail were largely ignored. The historical pattern of clustering at a few well-worn campsites continued. Most of the campers attributed their choice of a campsite to the convenience of being near the trail and/or at a previously cleared site.

Designated-Dispersed Campsites. A subsequent study, being conducted in both a Wilderness and a non-Wilderness backcountry area, is evaluating the use of "designated-dispersed" campsites. These are lightly cleared sites located at least 200 feet off the trail. There are no facilities except for a marked route between the campsite and the main trail. The marked route is being used to eliminate the possibility that hikers are timid about straying far from the well-worn trails. The designated sites were chosen with a variety of physical characteristics in order to learn more about backpackers' preferences for campsites (Fig. 9).

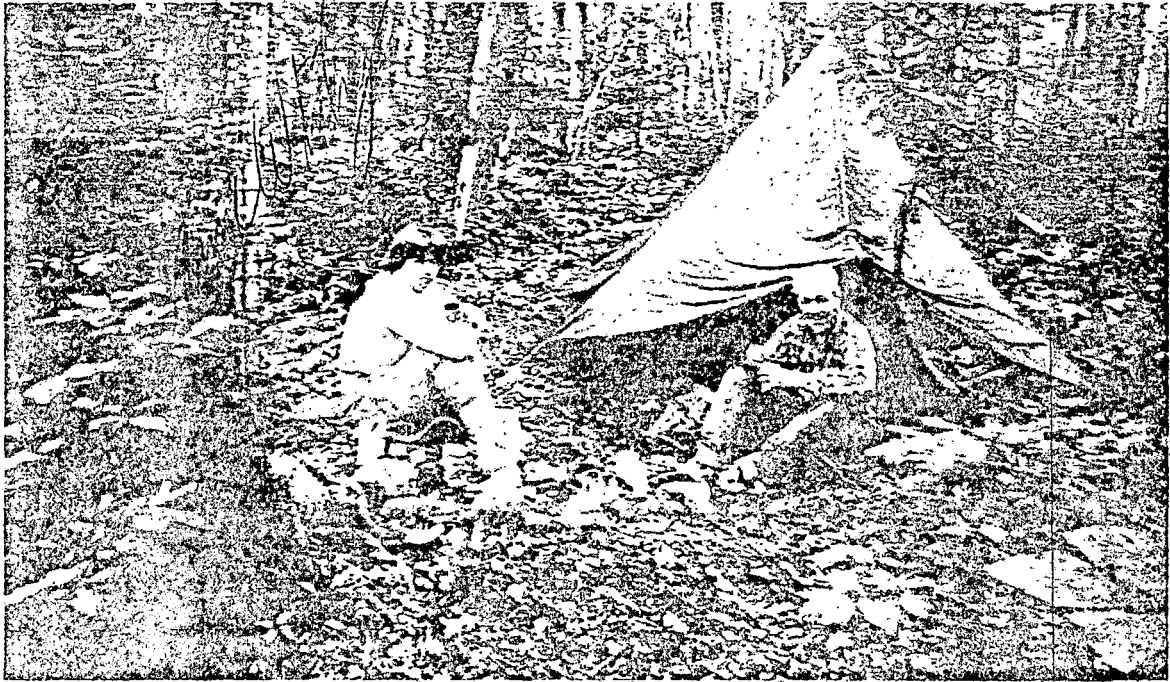


Fig. 9--Two backcountry campers utilizing a designated dispersed campsite.

Visitor Counts. It has been necessary to develop methods to count the number of people using the backcountry facilities. Visitor use figures are needed in order to answer two questions: How does visitor use correlate with site deterioration, and how well do people disperse in the backcountry?

Day and overnight visitors to statutory Wilderness Areas are required to obtain free permits before using the areas. The reliability of the permit system to determine trail use was evaluated. The hikers' compliance with this regulation has been very good for overnight hikers (80-90 percent compliance), but less than good for day hikers who have about a 70 percent compliance rate. Hikers were also found to use trails other than those they specified on their permits, thus further reducing the accuracy of this system for learning travel patterns.

Pressure-plate counters have proven to be a very useful method for counting trail users. Hikers trigger a battery-powered counter by stepping on a doormat-size plate buried several inches below the trail surface. This counter has been found to be at least 90 percent accurate as long as it is checked periodically for battery failure or loose wires (Figs. 10 and 11).



Fig. 10--The Pressure Plate, sandwiched between two plywood slabs, protected with a layer of plastic and burlap, is buried several inches below the trail surface.

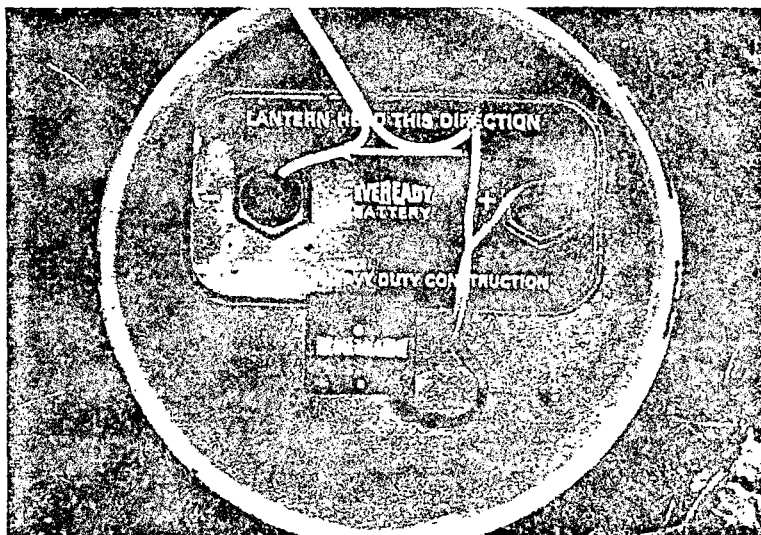


Fig. 11--A 6-volt battery and counting mechanism are housed in a plastic container, wired to the Pressure Plate and camouflaged adjacent to the trail.

Site Development Costs. A system for determining backcountry site development and maintenance costs is being developed. The system will indicate what facilities and site maintenance needs are required to accommodate different visitor levels on different physical land types. This system, used as a planning tool, could assist managers to find "design capacities" for their backcountry recreation land, as well as plan their budgets to handle new backcountry recreation needs.

Trail reconstruction and maintenance work has been observed on about 100 miles of trails in the White Mountain National Forest. The type and amount of trail stabilization that is needed for different land types under different use levels is being analyzed. Trails that traverse the lower slopes of valleys with deep, sandy outwash have received only one-half hour of maintenance work per 500 feet of trails over a five-year period. These appear relatively inexpensive to maintain at any use level. In contrast to this, trails that climb the upper mountain slopes having shallow and bouldery soils on grades greater than 30 percent have received up to 36 hours of maintenance work per 500 feet of trail over the five-year period. These appear to be the most expensive trails to maintain and their costs vary with the amount of hiking use they receive (Fig. 12). Information such as this will be incorporated into the cost model.

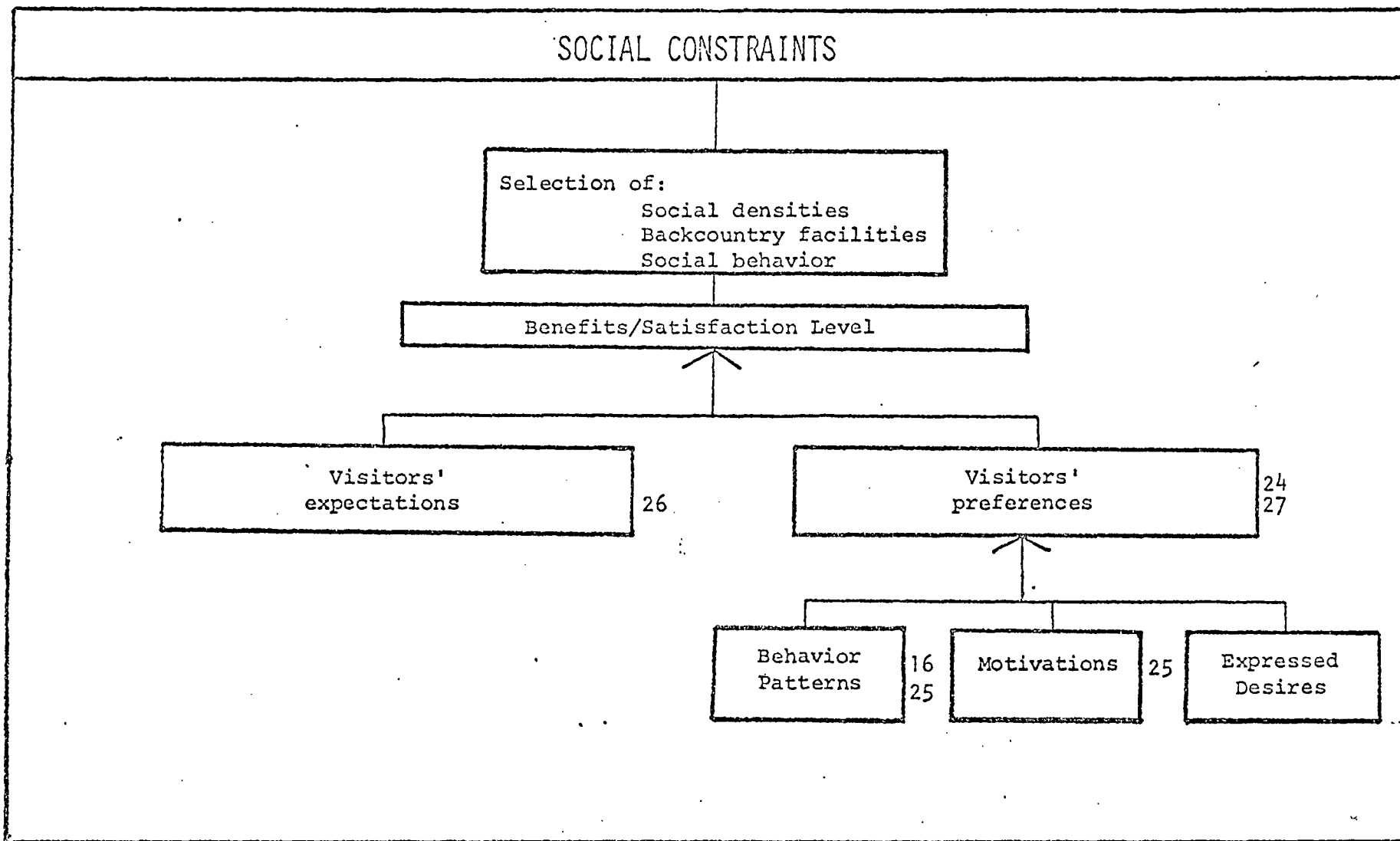


Fig. 12--Maintenance structures increase a trail's durability to hiker traffic.

Social Constraints

Recreation researchers at other Forest Service units have studied the social characteristics of backcountry visitors and queried some of their attitudes and preferences. From this research it appears that in order to satisfy most of the visitors, a spectrum of recreational opportunities will have to be provided (Fig. 13). These should include areas offering different levels of solitude and facilities. Further research is needed to better define the acceptable use levels and appropriate manmade facilities for different backcountry areas. Ongoing social research at other Forest Service units should provide much of this information.

Figure 13. Research areas within social constraints.



PUBLICATIONS LIST

- Branch, J. R., and S. C. Fay.
1977. Recreation management planning for a multi-use river corridor. Paper presented at River Recreation Symposium, Minneapolis, MN, Jan. 25-27, 1976.
- Canon, L. K., Steven Adler, and R. E. Leonard.
1979. Factors affecting dispersion of backcountry campsites. USDA For. Serv. Res. Note NE-276, 6 p.
- Ciali, C. P., R. E. Leonard, and J. J. Lindsay.
1978. Collecting hiker information in the backcountry. Univ. of Vermont Res. Rep. SNR-RM4, 18 p. Univ. of Vermont Recreation Dept., Burlington.
- Dindal, D., and L. Levintan.
1976. The soil invertebrate community of composting toilet systems. Proc. of VI Colloquium on Soil Zoology, Uppsala, Sweden.
- Echelberger, H. E., R. E. Leonard, and M. L. Hamblin.
1978. The trailguide system as a backcountry management tool. USDA For. Serv. Res. Note NE-266, 5 p.
- Echelberger, H. E., and Silas Little, Jr.
1979. Management of wooded areas for intensive recreation. In Urban Forester's Notebook, USDA For. Serv. Gen. Tech. Rep. NE-49, 191 p.
- Fay, Stephen C.
1975. Groundcover vegetation management at backcountry recreation sites. USDA For. Serv. Res. Note NE-201.
- Fay, S. C., and R. E. Leonard.
1977. Handling backcountry privy wastes by bin composting. APPALACHIA, December, p. 118-122.
- Fay, S. C., and R. E. Leonard.
1979. Composting privy wastes at recreation sites. Comp. Sci. 20(1):36-39.
- Fay, S. C., and R. H. Walke.
1977. The composting option for human waste disposal in the backcountry. USDA For. Serv. Res. Note NE-246.
- Godin, V. B., and R. E. Leonard.
1976. Guidelines for managing backcountry travel and usage. TRENDS, April/May/June, p. 33-37.
- Godin, V. B., and R. E. Leonard.
1977. Design capacity for backcountry recreation management planning. J. Soil and Water Conservation, July-August, p. 161-164.
- Godin, V. B., and R. E. Leonard.
1977. Design capacity for management decision-making. Proc. of Quantitative Ecology Workshop, College of Life Sciences and Agric., Univ. of New Hamp., Durham, p. 53-54.

- Godin, V. B., and R. E. Leonard.
1977. Permit compliance in Eastern wilderness. USDA For. Serv. Res. Note NE-238.
- Godin, Victor, and R. E. Leonard.
1979. Management problems in designated wilderness areas. J. Soil and Water Conservation 34(3):141-143.
- Godin, Victor B., Raymond E. Leonard, and Quentin Buck.
1977. Who is violating the law of the land? APPALACHIA 41(4):8-20.
- Leaf, A. L., and R. E. Leonard.
1976. Use of fertilizers for non-wood production benefits. Proc. XVI IUFRO Congress, Oslo, Norway.
- Leonard, R. E.
1976. Design capacity: A possible approach to some backcountry recreation management problems. APPALACHIA 42(2):20-21.
- Leonard, R. E.
1976. Design concept for management decision-making at dispersed recreation sites. Paper presented at Ruth E. Farrington Fund Quantitative Ecology Workshop. December 1-3, Durham, NH.
- Leonard, R. E.
1979. Resource protection: A problem analysis. In Burch, William R., Jr. (ed.) Long Distance Trails - The Appalachian Trail as a Guide to Future Research and Management Needs. Yale Univ., New Haven, CT.
- Leonard, R. E., H. E. Echelberger, H. J. Plumley, and L. W. Van Meter.
1979. Management guidelines for monitoring use on backcountry trails. USDA For. Serv. Res. Note NE-286.
- Leonard, R. E., H. E. Echelberger, and M. Schnitzer.
1978. Use characteristics of the Great Gulf Wilderness. USDA For. Serv. Res. Pap. NE-428, 9 p.
- Leonard, R. E., and S. C. Fay.
1978. A compost bin for handling privy wastes: Its fabrication and use. USDA For. Serv. Res. Note NE-254.
- Leonard, R. E., and H. J. Plumley.
1979. Human waste disposal in Eastern backcountry. J. For. 77(5):349-352.
- Leonard, Raymond E., and Harriet J. Plumley.
1979. The use of soils information for dispersed recreation planning. Paper prepared for Recreation Impacts on Wildlands Symposium, October 27, 1978, Seattle, WA.
- Leonard, R. E., H. J. Plumley, and W. R. Holman.
1977. A design capacity system. In Proc. National Trails Symposium, Lake Junaluska, NC, Sep. 8-10, 1977.
- Leonard, R. E., and A. M. Whitney.
1977. Trail transect: A method for documenting trail changes. USDA For. Serv. Res. Pap. NE-389.

Marchand, Peter J.

1977. Subalpine bogs of the Mahoosuc Range, Maine: Physical characteristics and vegetation development. Center for Northern Studies, Wolcott, VT, 19 p.

Plumley, H. J., H. T. Peet, and R. E. Leonard.

1978. Records of backcountry use can assist trail managers. USDA For. Serv. Res. Pap. NE-414, 19 p.

Rupe, Mary Lynn, R. E. Leonard, and J. J. Lindsay.

1979. Hikers' views of backcountry management. Univ. of Vermont Res. Rep. SNR-RM6. Univ. of Vermont Recreation Dept., Burlington.

Spencer, E. L., S. H. Surgenor, and R. E. Leonard.

1976. Backcountry research: The Mahoosuc Laboratory. APPALACHIA XLI(1):101-109.

Voglemann, H. W., R. E. Leonard, and C. C. David, Jr.

1979. The effects of fertilizer on alpine vegetation in the Green Mountains of Vermont. Paper in preparation.

REPORTS AND GUIDELINES

1. Guidelines for Design and Location of Backcountry Overnight Facilities, 91 p.
2. Guidelines for Constructing Backcountry Overnight Facilities, 36 p.
3. A Manual for Bin Composting. Office Report.

STUDY ABSTRACT

Study No. FS-NE-1903-1C

Study Title: Assessment of Productivity of Mountain Soils (With View for Possible Future Cultural Treatments (Mountain Soils-1)

Study Location: Mountain Ranges in Northeastern U.S.

Schedule: Begin - June, 1975 Estimated Completion - December, 1977

Assignment: Dr. Albert Leaf, SUNY, College of Forestry, Syracuse, N.Y. and R. E. Leonard, Durham, N.H.

Cooperation: Research Foundation of State University of New York, Cooperative Aid Agreement No. 23-644

Abstract:

Problem: There is a noticeable lack of information on the productivity of high elevation soils in Northeastern U.S. and the magnitude of their variability. The increased use of these areas by people and the management options for cultural treatments has resulted in a need for more information on these areas.

Objectives: (1) Evaluate productivity of mountain soils, (2) Assess variability of mountain soils.

Methods: Plots will be established at intervals along 1,000 foot elevation difference transects from the top of peaks supporting largely balsam fir (*Abies balsamea* L.) stands, in each of four cardinal directions. Plots for both extensive and intensive measurements of vegetation and soils will be established.

STUDY ABSTRACT

Study No.: FS-NE-1903-2C

Study Title: The Ecology of Alpine Plant Associations on the High Peaks of the Northeastern U.S. (Alpine Plant Associations)

Study Location: Bigelow Mountain, Maine; Mt. Mansfield, Vermont; Mt. March, New York

Schedule: Begin - June, 1975 Estimated Completion - Dec., 1977

Assignment: Dr. H. W. Vogelmann, University of Vermont and R. E. Leonard, Durham, N.H.

Cooperation: University of Vermont, Cooperative Aid Agreement No. 23-681

Abstract:

Problem: Vegetation at high elevations is easily disrupted by foot travel or other disturbances. Once damaged, the vegetation loses its stability and deteriorates. With the loss of plant cover, the soils at high elevations rapidly erode.

Objectives: (1) To describe the alpine plant associations in the high elevations of New York and New England, (2) To relate occurrence of major alpine plant communities to some environmental factors.

Methods: Alpine-arctic communities on each summit will be selected and analyzed using 1 x 1 meter quadrants, arranged along transects ranging from most exposed windward summits to areas on the lee side of the mountain.

STUDY ABSTRACT

Study No.: FS-NE-1901-3C

Study Title: Direct Gradient Analysis of Mountain Bog Vegetation
(Mountain Bog Vegetation)

Study Location: Mahoosuc Range, New Hampshire and Maine

Schedule: Begin - May, 1976 Estimated Completion - Dec., 1977

Assignment: Dr. Peter Marchand, Center for Northern Studies, Wolcott,
Vermont and R. E. Leonard, Durham, N.H.

Cooperation: The Center for Northern Studies, Wolcott, Vermont,
Cooperative Aid Agreement No. 23-766

Abstract:

Problem: Just where mountain bogs fit, in terms of their physical character and community structure, has not been investigated. Fundamental to understanding of the potential impacts of any disturbance to mountain bog communities, whether natural or man caused, is a knowledge of the present nature of these communities in terms of both their physical character and vegetative structure. The present literature is of little help since mountain or alpine bogs are so poorly represented. The information this study gathers, will be useful in determining methods of managing use in areas with high elevation bogs.

Objectives: To develop a thorough physical and vegetative characterization of a small group of high elevation bogs in northern New Hampshire.

Methods: High elevation bogs in the Mahoosuc Range will be sampled for vegetation, surface and subsurface topography, and for selected soil/water physical and chemical properties. A .5 meter wide belt transect will traverse each study site at regular intervals and serve as a sampling unit.

Results:

Soils at the "subalpine bog" sites studied are commonly deeper than 50-cm and have a high fiber content. Their nutrient status is ombrotrophic with low concentrations (less than 1.1-mg/l) of orthophosphate and (less than 4-mg/l) of calcium. These bog sites characteristically range between 3.8 and 4.0 in pH.

Four vegetative communities are described: Carex/Sphagnum, Scirpus/Drepanocladus, Rubus/Sphagnum, and Eriophorum/Cetraria. A working hypothesis of bog succession is proposed in which two successional pathways (involving Rubus/Sphagnum and Eriophorum/Cetraria) lead from Scirpus/Drepanocladus to a heath shrub community.

Frozen peat lenses were found at many bog sites. They were present until a series of late August rainstorms melted them.

STUDY ABSTRACT

Study No.: FS-NE-1903-4

Study Title: Soil Erosion on Backcountry Trails (Trail Erosion-1)

Study Location: Doublehead Mountain, Jackson, New Hampshire

Schedule: Begin - June, 1974 Estimated Completion - Dec., 1977

Assignment: R. E. Leonard, Durham, N. H.

Cooperation: None

Abstract:

Problem: The backcountry trails of the northeastern United States are receiving an increasing amount of use each year. This has led to extensive trail erosion. In the past, backcountry managers have relied on their own experiences in selecting trail sites where erosion control measures should be installed. Some means of identifying important variables affecting trail erosion and integrating them into a simple field test to evaluate the erosion potential of a trail is needed.

Objectives: (1) To develop methods to identify trail areas of high potential erosion, (2) To document the field sites of high potential erosion and (3) To develop a simple field test to determine the erosion potential of a trail site.

Methods: At each of the nine study plots certain variables will be measured once while others will be remeasured over the period of the study. Variables to be measured once include: (1) percent slope, (2) slope length, (3) soil depth to pan or bedrock, (4) soil bulk density and (5) pH. Variables to be measured every 14 days include: (1) trail width, (2) soil loss, (3) percent area coverage, (4) species composition of trailside vegetation and (5) the number of one-way trips on the trail. These re-occurring measurements will be made between approximately June 15 and September 15 for the duration of the study.

STUDY ABSTRACT

Study No.: FS-NE-1903-5C

Study Title: Physical and Biological Interaction on a Trail-Shelter Ecosystem (Trail Erosion -2)

Study Location: Mahoosuc Range, Berlin, N. H.

Schedule: Begin - June, 1974 Estimated Completion - Dec., 1977

Assignment: E. Spencer, Appalachian Mountain Club, and R. E. Leonard, Durham, N.H.

Cooperation: Appalachian Mountain Club, 5 Joy Street, Boston, Mass., Cooperative Aid Agreement No. 23-00-469

Abstract:

Problem: The backcountry areas of the northeastern U. S. are receiving an increasing amount of use each year. This has led to extensive trail erosion on the trail-shelter ecosystem. In the past, backcountry managers have relied on their own experience in selecting trail sites where trail erosion measures should be installed. To ease this burden and make trail management more effective, a simple field system of selecting trail sites which have a high potential for erosion should be developed.

Objectives: (1) To develop methods and determine the information required to describe the biological and physical characteristics of a trail-shelter ecosystem in order to facilitate prediction of changes in the ecosystem, (2) To quantify and qualify interaction among physical and biological variables in a trail-shelter ecosystem, (3) To develop a simple field method of determining trails which have a high potential for erosion.

Methods: At each of the nine study plots certain variables will be measured once while others will be remeasured over the period of the study. Variables to be measured once include: (1) percent slope, (2) slope length, (3) soil depth to pan or bedrock, (4) soil bulk density and (5) pH. Variables to be measured every 14 days include: (1) trail width, (2) soil loss, (3) percent area coverage, (4) species composition of trailside vegetation and (5) the number of one-way trips on the trail. These re-occurring measurements will be made between approximately June 15 and September 15 for the duration of the study.

STUDY ABSTRACT

Study No.: FS-NE-1903-6

Study Title: Backcountry Trail Degradation (Trail Erosion-3)

Study Location: The Long Trail, Appalachian Gap to Smugglers Notch, Vermont

Schedule: Begin - 1975 Estimated Completion - Continuing

Assignment: Mr. L. VanMeter, Green Mountain Club, Waterbury, Vermont, and R. E. Leonard, Durham, N.H.

Cooperation: Green Mountain Club, Waterbury, Vermont

Abstract:

Problem: Increasing recreational use of the backcountry in the northeast U.S. has led to extensive trail degradation. In the past backcountry managers have relied on experience and intuition in selecting sites of minimum degradation potential and in determining what rehabilitation techniques should be used. A more objective, standardized method of identifying the relative importance of factors affecting trail degradation is needed. To draw up such a method, trail degradation must be monitored and documented.

Objectives: To document field sites of high potential degradation.

Methods: At each of the nine study plots certain variables will be measured once while others will be remeasured over the period of the study. Variables to be measured once include: (1) percent slope, (2) slope length, (3) soil depth to pan or bedrock, (4) soil bulk density and (5) pH. Variables to be measured every 14 days include: (1) trail width, (2) soil loss, (3) percent area coverage, (4) species composition of trailside vegetation and (5) the number of one-way trips on the trail. These re-occurring measurements will be made between approximately June 15 and September 15 for the duration of the study.

STUDY ABSTRACT

Study No.: FS-NE-1903-7C

Study Title: Water Quality of a Remote Lake Subject to Use by Dispersed Outdoor Recreationists (Water Quality Impact)

Study Location: St. Regis Pond, New York

Schedule: Begin - May, 1976 Estimated Completion - Dec., 1978

Assignment: Dr. R. G. Werner, SUNY, College of Forestry, Syracuse, N.Y. and R. E. Leonard, Durham, N.H.

Cooperation: Research Foundation of State University of New York, Albany, N.Y., Cooperative Aid Agreement No. 23-754

Abstract:

Problem: Extent of disturbances, caused solely by self-propelled recreationists, on remote lakes has not been quantitatively determined.

Objectives: (1) To determine selected indicators of water quality of remote lakes subject to seasonally heavy use by self-propelled outdoor recreationists, (2) To identify among the parameters measured those parameters which may present an existent, or potential, threat to the quality of the water and, indirectly, the quality of the recreation experience.

Methods: Data will be collected periodically, during the hiking season, on the limnological parameters of the remote lake in the Adirondack region of New York. Baseline values will be established before the hiking season begins, along with an elemental soil survey of the shore line. Recreational use will be monitored throughout the season.

STUDY ABSTRACT

Study No.: FS-NE-1903-8C

Study Title: Investigation of Techniques and Equipment Development to be Used in Field Measurements of Water Quality Parameters in Backcountry Areas (Water Quality Techniques)

Study Location: Mahoosuc Range, New Hampshire and Maine

Schedule: Begin - June, 1975 Estimated Completion Dec., 1977

Assignment: Carl Brandt, Brandt Laboratories, Pennsylvania; Sally Surgeoner, AMC, Gorham, N.H.; and R. E. Leonard, Durham, N.H.

Cooperation: Brandt Associated, Consulting Analytical Chemists, Martins Creek, Pennsylvania, Cooperative Agreement Supplement No. 23-746

Abstract:

Problem: The increased use of the backcountry in northeastern U.S. by recreationists in recent years has led to concern over degradation of water quality in high elevation lakes and streams. Reliable field methods are needed to simplify the observation of water quality changes in remote areas.

Objectives: (1) To develop techniques and equipment to be used in the field measurement of water quality parameters, (2) To document water quality parameters in certain high elevation waters.

Methods: A set of lakes, ponds, streams, and wetlands in the Mahoosuc Range will be selectively chosen. These will be representative of a spectrum of conditions in situations across the range. At each of the selected lakes and streams, duplicate water samples will be taken on a regular basis. One sample will be subjected to a series of water quality tests in the field, utilizing equipment and techniques developed by the cooperator. Parameters to be measured in the field include: temperature, pH, dissolved oxygen, nitrogen, phosphorus, calcium, iron, sulfur, etc. The duplicate of this sample will be sent to the cooperator's laboratory, where certain of these tests will be replicated under controlled conditions.

Results:

Development of field techniques and equipment for nutrient analysis were unsuccessful due to instrument failure and electrical line problems that precluded the highly sensitive nature of the measurements and analyses. However, a battery of other tests were performed on 256 samples. These included incubation for fecal coliform by Millipore filtration within 4-6 hours of sampling, pH, conductivity, and alkalinity-acidity tests.

Results present an overall pattern of clean water. The ion tests performed concurrently to the bacteria analyses reveal a totally buffered, low pH water source with extremely specific conductants and dissolved ion compounds close to or below atomic absorption detection limits. Specific conductants proved consistent within a few units (mmhos/cm) for each individual site throughout all sampling dates. An apparent relationship between conductants and topographical location was revealed.

Fecal contamination of backcountry water supplies is likely from three sources: Human, wildlife, and domesticated animals. Data from this study indicated that 65% of the water samples met recommended federal health standards. A small percentage of the remainder --possibly 0--might have resulted in an intestinal disturbance. The only way to be assured of hazard-free water is to boil it or add chemicals.

STUDY ABSTRACT

Study No.: FS-NE-1903-9C

Study Title: Soil Invertebrates and Microorganisms Associated with Decomposition of Human Solid Waste in Mountain Campsites in Northeastern U.S. (Soil Invertebrates)

Study Location: Danby, Vermont

Schedule: Begin - June, 1975 Estimated Completion - June, 1977

Assignment: Dr. D. L. Dindal, Department of Zoology, SUNY, College of Forestry, Syracuse, N.Y. and R. E. Leonard, Durham, N.H.

Cooperation: Research Foundation of the University of New York, Albany, N.Y., Cooperative Aid Agreement No. 23-645

Abstract:

Problem: A Clivus (dry toilet) solid waste unit has been operated for two years in a mountain campsite in Vermont. Human feces, urine, paper and some garbage have been deposited in this unit. To date, composting of these wastes have been very successful with the ultimate formation of an apparent rich humus-like product. Monitoring of odor, moisture level and temperature seem to support the fact that natural decomposition is complete. In order to verify this several biological factors should be investigated.

Objectives: (1) To compare soil invertebrate populations and community structure of waste compost and surrounding natural soil and (2) To determine rates of decomposition.

Methods: (1) At least four samples from both the composted material within the Clivus chamber and the surrounding natural soil will be collected no less than once a year (if possible, sampling may be once each month of peak usage). The community structure and population of soil invertebrate decomposers will be assayed and compared for each sampling period. (2) Using the litter bag technique, known weight of solid waste test material will be placed in the excrement chamber, refuge chamber and storage chamber of the composting container. These will then be retrieved periodically, weighed and extracted to determine rates of decomposition.

Results:

Nineteen taxa of invertebrates are commonly associated with the decomposer community. Dominant and subdominant decomposers, along with their related predators and parasitoids comprise the functional community structure. Among these, dipterin larva are the most abundant insect form with Fannia representing the dominant genus. Finally, arthropods, such as oribatei which dominated the initial soil inoculum, are gradually reduced and

replaced by different soil decomposers that are adapted to more heterotrophic conditions once the waste collection unit is in operation.

Organic material possessing relatively low C/N ratios support the large invertebrate communities and are most readily decomposed. Relatively high C/N values lead to slow colonization and low species diversity. In addition to low C/N values, the moisture absorptive capacity by different organic materials appears to increase rates of invertebrate colonization and decomposition.

STUDY ABSTRACT

Study No.: FS-NE-1903-10

Study Title: Composting Human Waste at Dispersed Recreation Sites
(Composting-1)

Study Location: Mt. Mansfield and Camels Hump, Vermont

Schedule: Begin - May, 1977 Estimated Completion - Oct., 1977

Assignment: R. E. Leonard, Durham, N.H.

Cooperation: None

Abstract:

Problem: Bark-sewage composting is known to be a hygienic method of human waste disposal. Inaccessibility and handling problems confound the method in the backcountry. Information is needed on the feasibility of the proposed compost system, including cost, through on-site experience.

Objectives: (1) To design an on-site operational composter based on existing knowledge, (2) To determine the feasibility of the on-site composting operation.

Methods: A series of about six shelters will be selected. The proposed system will be installed at each location. A diary approach will be utilized by a ridge-runner/composter to document cost and perceived problems.

Results:

Pre-built bins, weighing about 75 pounds each, were packed into four sites in the Green Mountains of Vermont. Each trip was about two miles, and took two packers about three hours. The mixture required to process the human waste was about 7 pounds of ground hardwood bark for each gallon of privy waste. Results indicate that a single bin is more than sufficient to handle more than 10 people per night as well as an unknown number of day visitors. Based on this study, the bin composting system, including a new outhouse, would cost about \$252 per year to process about 192 pounds of waste, for 10 years. Caretaker acceptability of the system was good.

STUDY ABSTRACT

Study No.: FS-NE-1903-11

Study Title: Documenting Backcountry Campsite Conditions Over Time:
An Evaluation of Photography and Ground Control Methods
(Photography-Campsites)

Study Location: Ten Shelter Sites Located Along the Long Trail, Vermont

Schedule: Begin - June, 1977 Estimated Completion - Dec., 1980

Assignment: R. E. Leonard, Durham, N.H.

Cooperation: None

Abstract:

Problem: Hiking and camping have become the fastest-growing recreation activities in the northeastern backcountry areas. Results are widespread deterioration of backcountry campsites. Managers faced with rehabilitation or relocating campsites have relied on experience and intuition in decision-making. A more systematic and objective method is needed to (a) identify changes in campsite conditions over time and (b) document rationale behind policies and action.

Objectives: (1) To develop a standardized, easily used photographic system for recording site conditions, (2) To evaluate the system against existing ground-control methods which may be used to gather similar information and (3) to make a two-year comparison of Long Trail shelter mosaics photographed in 1975, with those produced by this study.

Methods: Permanent photo-points will be established at each site using several methods. A grid will be set up in the shelter facility with various equipment and procedures used to photograph a 360 mosaic. Color, black and white, and infra-red film will be used. Two systems of ground-control-transects, in a radial plot will be evaluated.

STUDY ABSTRACT

Study No.: FS-NE-1903-12

Study Title: Methods for Quantifying Vegetation Change (Vegetation Methods)

Study Location: Northern New Hampshire

Schedule: Begin - May, 1977 Estimated Completion - Dec., 1978

Assignment: R. E. Leonard, Durham, N.H.

Cooperation: None

Abstract:

Problem: Techniques to accurately document the vegetation changes under backcountry recreation conditions are not complete. There is a need to have record of actual changes before assumptions can be made on the nature of recreational impacts.

Objectives: To determine systems to quantify vegetation change under a variety of backcountry conditions.

Methods: (1) A literature review of existing sampling procedures and (2) Field testing of existing and new methods will work to refine information-gathering techniques and analysis.

STUDY ABSTRACT

Study No. FS-NE-1903-13

Study Title: Soil Factors That Affect Trail Durability
(Soil Durability)

Study Location: New England

Schedule: Begin - May, 1979 Estimated Completion - Dec., 1980

Assignment: R. E. Leonard, Durham, NH

Cooperation: None

Abstract:

Problem: Backcountry trails cross a variety of soil types, some having more or less ability to withstand human use. In order to set capacities and determine possible maintenance costs of trails, the underlying factors that determine durability must be discovered.

Objective: To determine those soil physical and chemical properties that affect its ability to withstand human use.

Methods:

(1) A literature review of soil characteristics that affect erosion and compaction will be made.

(2) At trail transect sites already in use, the samples will be collected and analyzed for the relationship between erosion and soil characteristics.

STUDY ABSTRACT

Study No. FS-NE-1903-14

Study Title: Survey of Offshore Island Ecosystems With the Potential for Recreational Use (Islands)

Study Location: Northeast Coast

Schedule: Begin - July, 1977 Estimated Completion - Dec., 1980

Assignment: R. E. Leonard and A. M. Whitney, Durham, New Hampshire

Cooperation: None

Abstract:

Problem: Increased recreational use of northeastern offshore islands appears to be imminent. Both federal and state agencies are planning for a limited dispersed recreation on these islands. Presently, there is a need to document the physical and biological properties of this unique ecosystem, especially with respect to recreational impacts. This documentation can provide valuable information for assessing island durability before specific uses and facilities are established.

Objective: To determine the feasibility of offshore islands for dispersed recreation, particularly as it regards the potential impact of recreation on this fragile ecosystem.

Methods:

- (1) Conduct a survey involving literature review and ground reconnaissance to locate potential study sites.
- (2) Characterize the biological and physical conditions of chosen sites, through documentation of major vegetation types, soil properties, topography and climate.

STUDY ABSTRACT

Study No. FS-NE-1903-15

Study Title: Vegetation Factors That Influence Durability Near and Adjacent to Trails (Vegetation Durability)

Study Location: Northern New Hampshire

Schedule: Begin - June, 1978 Estimated Completion - Dec., 1980

Assignment: R. E. Leonard, Durham, N. H.

Cooperation: None

Abstract:

Problem: Locating a hiking trail through any environment would tend to produce changes in ecology of the trail site and immediate adjacent land. An understanding of factors that can influence plant durability against degradation will aid in the design and maintenance of hiking trails.

Objective: Identify the physical and biological factors influencing the vegetation under trailside conditions.

Method: Monitor the effect of the physiological and climatic factors on plant growth and diversity at selected trail sites.

STUDY ABSTRACT

Study No. FS-NE-1903-16

Study Title: Permit Reliability, Travel Patterns, and Overnight Use in WMNF Wilderness Areas (Wilderness Use)

Study Location: Great Gulf Wilderness Area, WMNF

Schedule: Begin - June, 1976 Estimated Completion - Jan., 1977

Assignment: Dr. R. E. Leonard, Durham, New Hampshire

Cooperation: None

Abstract:

Problem: By authority of the 1964 Wilderness Act the Forest Service is charged "to protect and manage (these areas) so as to preserve its natural condition." An indication of number of users, their travel patterns, and nature of overnight use must be developed to assure rational achievement of this charge.

Objective:

- (1) To determine travel patterns in the Great Gulf Wilderness.
- (2) To characterize overnight use in the Great Gulf Wilderness.

Method: A system of trail counters at trailheads and an evaluation of visitor permits will be used to establish patterns and overnight use.

Results:

Three use characteristics were studied in the Great Gulf Wilderness of the White Mountain National Forest in 1976. Use quantity, use distribution, and overnight use patterns. Pressure-plate counters, in conjunction with use permits and site observations, were used to acquire data. Approximately 4,000 people visited this area during the 56-day study period. Seventy-five percent were day users and 25 percent were overnight users. Trail use ranged from 50 hikers per day to negligible use. Overnight users tended to concentrate in the upper portion of the Great Gulf. Actual overnight use is significantly lower than permitted use. On some nights, more than half of the users who obtained overnight permits did not use them.

STUDY ABSTRACT

Study No. FS-NE-1903-17

Study Title: Economical Sampling Techniques for Obtaining Trail Use Estimates (Self-Registration)

Study Location: Appalachian Trail, Vermont, New Hampshire

Schedule: Begin - May, 1976 Estimated Completion - October, 1976

Assignment: R. E. Leonard, Durham, NH

Cooperation: None

Abstract:

Problem. Self-registration boxes appear to be the most economical way to obtain trail use estimates as well as additional visitor use information. However, sign-in rates (compliance rates) for these boxes have been found to vary widely among geographic regions. Estimates of compliance rates must be determined for most registration boxes before the manager can have confidence in the use estimates. Volunteer validators could provide an inexpensive way of determining these rates.

Objective: To determine the effectiveness of volunteers to validate the number of hikers registering at trailside registration boxes.

Method: The Forest Service will provide registration boxes and forms to selected volunteers. The volunteers will set up the boxes and according to their own schedule, validate the compliance rates.

Results: Validation by volunteers was a mixed success. Some volunteers reliably made biweekly validations; others soon lost interest. Shelter site caretakers, who work for the Green Mountain Club, were able to include registration box validation time in their routine tasks. They were able to contribute more time to the validations than the volunteers. This was due primarily to their proximity to the boxes and their better understanding of the usefulness of the trail use estimates for making management decisions.

Although a self-registration system validated entirely by volunteers may not be feasible, a combined volunteer/paid caretaker program shows promise as an inexpensive means of monitoring trail use.

STUDY ABSTRACT

Study No. FS-NE-1903-17a

Study Title: A Study to Enrich Pressure Plate Counter Data

Study Location: White Mountain National Forest, New Hampshire

Schedule: Begin: 5/79 Completion: 5/80

Assignment: Dr. Miklos Gratzner, SUNY College of Env. Sci. & For. Syracuse, NY 13210, and H. E. Echelberger, USDA For. Serv., NEFES, Durham, NH 03824

Cooperation: Research Foundation of State University of New York, Albany, NY
Cooperative-Aid Agreement No. 23-174

Abstract:

Problem: In response to the need of backcountry managers for information on backcountry use, pressure-plate counters have been implemented. However, they do not provide data on use patterns--group size, direction of travel, type of visitor (day or overnight), and traffic peaks and troughs. A better means of obtaining this kind of information is needed for planners and managers to develop reasonable dispersed recreation opportunities.

Objective: To develop and test a trail monitoring system that will provide managers with information on backcountry traffic patterns.

Method: A trail monitoring system will be designed using six pressure plate counters at two trail intersections and a self-registration box between the two intersections. A time-lapse photography site will be used to record traffic flow at an intersection one day per week for two months. The registration box and pressure plate counters will be operational at all times. On a camera monitoring day (once per week per intersection), the box between the intersection and counters at both intersections will be checked in the morning and afternoon, thus providing three sets of data for that trail system on that day. Comparisons of data and costs will be made for each technique.

STUDY ABSTRACT

Study No. FS-NE-1903-18C

Study Title: Effect of Fertilizer on Alpine Tundra Vegetation

Study Location: Camel's Hump, Vermont

Schedule: Begin - May, 1975 Estimated Completion - Dec., 1977

Assignment: Dr. H. V. Vogleman, University of Vermont and
R. E. Leonard, Durham, New Hampshire

Cooperation: University of Vermont, Burlington, Vermont
Cooperative-Aid Agreement No. 23-646

Abstract:

Problem: Stabilizing vegetation at high elevation areas is difficult because alpine species are easily damaged and the disturbed alpine turf erodes rapidly under the heavy precipitation and high winds. Fertilizer has been used in some cases to ameliorate these problems. It is necessary to evaluate the use of such an additive treatment and ascertain some of the side effects from this treatment.

Objective: Investigate the response of alpine tundra vegetation to fertilization.

Method: Effects of fertilizer application of 10-10-10 will be tested on two vegetation types on the alpine summit of Camel's Hump. Ten square meter quadrats each will be laid out in sedge tundra and heath tundra. Fertilizer applications will take place in early summer, and in late August and the end of the growing season, the twenty plots will be charted.

Results:

The coverage curves for the same species in fertilized and unfertilized plots tend to parallel one another during the three seasons of the experiment. Only two species, Carex bigelowii and Potentilla tridentata, seem to show a consistent pronounced increase in cover in the fertilized plots over the unfertilized plots.

Species which increase in coverage more without fertilizer, or possibly were negatively affected by fertilizer, are Empetrum nigrum, Vaccinium uliginosum, and possibly Vaccinium vitis-idaea.

On the basis of bare ground exposure alone, it would be difficult to state that fertilizer improved total coverage in any appreciable way. The mere protection of alpine vegetation seems to allow development and expansion of existing cover on both fertilized and unfertilized plots. It would appear that there is also little change in the overall species composition of an alpine community due to increased nutrients over the three growing seasons.

STUDY ABSTRACT

Study No. FS-NE-1903-19

Study Title: Alternative for the Disposal of Sewage in the Backcountry (Sewage Alternative)

Study Location: Mt. Mansfield, Vermont

Schedule: Begin - June, 1975 Completion - June, 1976

Assignment: Mr. L. Van Meter, Green Mountain Club, Waterbury, VT and R. E. Leonard, Durham, New Hampshire

Cooperation: Green Mountain Club, Waterbury, VT

Abstract:

Problem: Heavy recreational use of backcountry areas in the northeast has caused serious human waste disposal problems, particularly at the higher elevations, where the soils are frequently unsatisfactory for safe use of the traditional pit-type outhouse. In many, if not most, high elevation campsites in the northeast, inadequate sanitary facilities pose a threat to water supply and disease.

Objective:

- (1) To examine a lysimeter study of waste disposal.
- (2) To examine a composting method of waste disposal.

Method: Lysimeters and tent composting units will be established at selected sites on Mount Mansfield and E. coli testing used for assessment of sanitary conditions.

STUDY ABSTRACT

Study No. FS-NE-1903-20

Study Title: Bark-Sewage Composting at Dispersed Recreation Sites (Composting - 2)

Study Location: Bartlett Experimental Forest, Bartlett, NH

Schedule: Begin - July, 1976 Completion - January, 1978

Assignment: Dr. R. E. Leonard, Durham, New Hampshire

Cooperation: None

Abstract:

Problem: Backcountry recreation shelter sites often have soils that are marginal or unsuitable for a soil-related method of human waste disposal. Self-contained alternatives need to be explored.

Objective:

- (1) To develop a simple, inexpensive, easily-operated and environmentally sound method of human waste disposal for dispersed recreation sites.
- (2) To field test this unit to document its method of operation and ability to produce a pathogen-free end product.

Method: A bark-sewage composting unit will be developed based on existing information. The unit will be tested for pathogen-destruction capabilities through the use of selected indicator organisms.

Results:

The disposal of human waste by composting at backcountry recreation areas is a possible alternative to methods that are considered unsafe. The literature indicates aerobic, thermophilic composting is a reliable disposal method that can be low in cost and maintenance. A bark-sewage mixture can be composted to produce a pathogen-free substance that can be used in site rehabilitation. Composting in a leak-proof bin is largely independent of site conditions.

STUDY ABSTRACT

Study No. FS-NE-1903-21C

Study Title: Firetowers as a Management Tool in the Backcountry
(Firetowers)

Study Location: Stratton Mountain, Vermont

Schedule: Begin - May, 1976 Completion - January, 1978

Assignment: Mr. L. Van Meter, Green Mountain Club, Vermont and
R. E. Leonard, Durham, New Hampshire

Cooperation: The Green Mountain Club, Rutland, VT
Cooperative-Aid Agreement No. 23-751

Abstract:

Problem: Firetowers were once common in New England. Over the past decade, however, most of these towers have been left unmanned or dismantled for a variety of reasons.

Objective: To investigate the feasibility of using manned firetowers as a tool for managing dispersed recreation.

Method: A firewatch will be stationed at the existing firetower facility on Stratton Mountain in Vermont. He will keep a log of the number of hikers, the size of the hiking party and their residence. He will also provide the historical, ecological and practical information of the region to those visiting hikers.

Results:

In 1976, the firewatch on Stratton Mountain contacted 1,443 hikers. In 1977, the contacts amounted to 1,187 hikers. Because not every hiker climbs the firetower and is able to sign the register book, these numbers are less than the estimated 3,000 hikers that pass beneath the Stratton Tower each year. Conversations between the firewatch and hikers typically included the values of camping and building fires (or using portable gas stoves) in designated areas along the trail; the need for strong leadership and thorough planning/organizing small hiking groups; and generally, how to behave to have minimal impact on trail environment.

Firetowers may serve as an effective educational tool for managing dispersed recreation. The cost of manning a firetower is partially offset by the reduction in vandalism.

STUDY ABSTRACT

Study No. FS-NE-1903-22C

Study Title: Operations Management of Backcountry Recreational Facilities (Operations Management)

Study Location: Eastern United States

Schedule: Begin - June, 1975 Complete - May, 1978

Assignment: Dr. V. B. Godin, Department of Business Management, Northeastern University, Boston, MA, and
R. E. Leonard, Durham, NH

Cooperation: College of Business Administration, Northeastern University, Cooperative-Aid Agreement No. 23-679

Abstract:

Problem: As increasing numbers of people turn to "backcountry" and "wilderness" areas as a source of leisure-time activities, land managers are being faced with new sets of biological, political, and administrative problems.

Objective: To investigate the administrative recreation management problems faced by backcountry managers.

Method: A major questionnaire will be mailed to several dozen managers to measure the frequency of occurrence of specific recreation management problems throughout the country.

Results: The Wilderness Act of 1964 designated a unique system of public lands. Managers of these wilderness areas face a number of problems. Some are common to backcountry regions throughout the country; others are peculiar to the management of these specially designated areas. We surveyed managers of 63 of the 125 officially designated wilderness areas (as of January 1975). Traditionally, researchers have questioned backcountry and wilderness visitors to ascertain their views. We directed our questionnaire to wilderness managers to determine management's views on operating and controlling forest resources and to determine what these managers perceived as their most important operating problems. Only one problem--site deterioration--was cited by more than half the respondents. Seven other problem areas were identified. The wilderness managers' perceptions of their severity varied from location to location. See Godin and Leonard (1979).

STUDY ABSTRACT

Study No. FS-NE-1903-23C

Study Title: Trail Guide System for Managing Dispersed Recreational Use (Trail Guide)

Schedule: Begin - May, 1976 Completion - June, 1977

Assignment: Dr. P. Graves, SUNY College of Forestry, Syracuse, NY and R. E. Leonard, Durham, NH

Cooperation: Research Foundation of State University of New York, Albany, New York
Cooperative-Aid Agreement No. 23-753

Abstract:

Problem: Managers of dispersed recreation areas are faced with a three-fold problem of providing information to the user. Three aspects of the problem are to provide pertinent information on trail directions, interpretive information on activity restrictions, and explanations of trail and campsite information. The number and dimension of conventional signs required to do this work is overwhelming. An informational and directional system that is inexpensive and unobtrusive is desirable.

Objective: Implement and evaluate an experimental trail signing system.

Method: A booklet will be prepared to provide descriptive information relating to numbered tags installed within a trail system. The booklet will be free and distributed with signed boxes at the trailheads. An evaluation of the idea and the design will be made and the comments returned to the box and to observational data taken at specific points on the trail system.

Results:

The trail guide system consists of a booklet containing a map, directional and distance data, and information about the natural and human history and management problems of a backcountry hiking trail. This booklet is keyed to small, numbered, wooden markers along the trail. It was found that the system was useful for contacting backcountry recreationists.

The system was set up on the Franconia Ridge Loop. Hikers did not perceive the booklet as a threat to their hiking experience. Instead, they were favorably impressed by it. Combined with user restrictions, site hardening, and other subtle techniques to shift use, this system may be helpful to managers facing increased use pressure on backcountry resources.

STUDY ABSTRACT

Study No. FS-NE-1903-24C

Study Title: Analysis of Recreation Use Alternatives for the Camel's Hump Section of the Long Trail (Camel's Hump Options)

Study Location: Camel's Hump, Waterbury, VT

Schedule: May, 1976 through December, 1978

Assignment: Dr. J. Lindsay, School of Forestry, University of Vermont, and R. E. Leonard, Durham, NH

Cooperation: School of Natural Resources, Univ. of Vermont, Burlington Cooperative-Aid Agreement 23-752

Abstract:

Problem: The Camel's Hump section of the Long Trail system and the accompanying approach trails are under an outdoor recreation use pressure that has resulted in several management problems for the Vermont Department of Forests and Parks and the Green Mountain Club which administers the area.

A system of dispersed recreation management will be evolved. A number of alternative management plans currently under construction will be analyzed using this system. This information will be useful in determining effective means of managing use.

Objective: Evaluate existing and proposed solutions to user impact problems on the Camel's Hump section of the Long Trail through the Green Mountains in Vermont.

Method: A questionnaire format will be used to record the opinions of managers and hikers on alternative management actions on Camel's Hump. This will be personally administered at shelter sites, left at shelter sites for hikers to fill out, and mailed to hikers and managers.

Results: A written survey was administered to hikers in an undeveloped state park in Vermont during 1977. The attitudes held by these hikers toward current and alternative management policies are discussed in this report.

Hikers expected low densities of use on the trail but indicated a tolerance for relatively frequent encounters with other hiking parties and only 1/10 experienced crowding on the day they were surveyed. Crowding was more of a problem at the overnight shelters in the area; one-third of the campers experienced crowding on the day they were surveyed and two-thirds experienced crowding on other occasions. Although campers did not agree on what density of use constituted a crowded condition at the shelter, the majority (78%) favored a mandatory limit on the size of individual parties. Ninety-seven percent thought the limit should be ten or fewer. As a means to ration hiking use if such controls become necessary, hikers preferred a permit requirement or a quota system on a first-come, first-served basis rather than a hiking license requirement or user fees. Three-fourths of the hikers, however, preferred trail hardening as a solution to overuse problems rather than rationing of hiking use. Other management policies that were examined included restrictions on overnight use, degree of trail maintenance, and the area's information/education program. See Rupe et al. (

STUDY ABSTRACT

Study No. FS-NE-1903-25C

Study Title: Decision-Making by Recreationists in Wilderness Areas
(Wilderness Decisions)

Study Location: Great Gulf Wilderness, White Mountain National Forest

Schedule: June, 1976 through December, 1976

Assignment: Dr. L. Canon, Department of Psychology, University of
New Hampshire and R. E. Leonard, Durham, New Hampshire

Cooperation: University of New Hampshire, Department of Sociology,
Durham, New Hampshire
Cooperative-Aid Agreement No. 23-778

Abstract:

Problem: Recreationists in wilderness areas tend not to choose dispersed sites for camping. This lack of dispersion has created problems of adverse physical impacts by recreationists on wilderness lands, as well as other management difficulties.

Social research that has been conducted in national forests and parks has dealt primarily with the social characteristics and attitudes of recreationists. Few studies have analyzed the motivations behind the recreationists' decision-making process. Information on what factors influence a person's decision to select specific campsites may provide ideas for new approaches to management strategy.

Objective:

- (1) Determine whether campsite selection is a function of perceived risk, which corresponds to the camper's social characteristics.
- (2) Determine the influence of increased information about where to camp on the selection of campsites.
- (3) Determine the influence of convenience factors on the selection of campsites.

Method: Data will be gathered by means of:

- (a) A permit registration form required of each individual who enters the wilderness area.
- (b) Unobtrusive observation by "ridgerunners" and the investigators.
- (c) An informal interview schedule.

The sample will consist of all users of a "busy" section of the trail. Careful measurements will be taken to guarantee the rights of the participants in terms of anonymity of the individual respondents and their rights to decline to be interviewed.

Results:

Observation along a "busy" section of the Great Gulf Trail revealed that none of the users fully complied with the area rules designed to promote site dispersion and to avoid recurrent use of particular sites. Survey responses suggest that users perceive hiking/camping in general and movement away from established trails in particular as involving an element of risk. Further, they indicated that convenience was an important determinant in their site selection. Finally, increased information designed to encourage dispersion was found to be associated with an increase in the average distance of sites from established trails.

STUDY ABSTRACT

Study No. FS-NE-1903-26C

Study Title: Hiker Traffic Patterns, Behavior, and Expectations in a Remote Trail/Shelter System (Expectations)

Study Location: Mahoosuc Range, Berlin, NH

Schedule: Begin - June, 1976 Complete - June, 1977

Assignment: E. Spencer, Appalachian Mountain Club, Boston, MA,
and R. E. Leonard, Durham, NH

Cooperation: Appalachian Mountain Club, 5 Joy St., Boston, MA
Cooperative-Aid Agreement No. 23-771

Abstract:

Problem: Recreational use of eastern backcountry areas has markedly increased. This influx has aggravated problems of trail erosion, vegetation damage, crowding, and littering. Information is lacking on preferred travel routes, length of stay, visitor behavior, and expectations that would be useful in more rational allocations of management funds and activities.

Objectives:

1. Determine visitor traffic patterns within certain backcountry trail systems to reveal preferred routes, heavily used trails, and average length of stay.
2. Identify various characteristics of user behavior and expectations on the trail system.

Method: This research will be carried out through observational studies and questionnaires.

Results: A sample of 112 hiking parties was interviewed in the Mahoosuc Range, Maine, to determine their reasons for visiting this particular area and their reasons for backpacking in general. The most important reason for hiking in the area was for enjoyment of nature, which corresponded to the reason (physical attributes) most hikers chose the Mahoosucs over another area. The least important reasons were for thrill seeking, family togetherness, and risk taking.

A comparison of the types of satisfactions desired and the social characteristics of the hikers revealed little differences between different social groups, though the sample sizes were too small to draw any definite conclusions.

STUDY ABSTRACT

Study No. FS-NE-1903-27C

Study Title: Sociological Profile of Hikers on the Long Trail System in Vermont (Social Profile of Hikers)

Study Location: Long Trail, Vermont

Schedule: Begin: June, 1975 Completion: December, 1977

Assignment: Dr. J. Lindsay, University of Vermont and R. E. Leonard, Durham, NH

Cooperation: University of Vermont, Department of Forestry, Burlington, VT
Cooperative-Aid Agreement Supplement No. 23-650

Abstract:

Problem: Use of Vermont backcountry trail systems has sharply increased in the last ten years, resulting in significant management problems. Information on Long Trail hikers and their equipment could be of significant value to land managers and future planning.

Objective: To draw up a profile and analysis of Long Trail hikers through observational techniques to aid backcountry land managers in developing management plans.

Method: A number of field cooperators will observe certain prescribed characteristics of hiking parties on the Long Trail. This data will be correlated and analyzed by a person with training and experience in social sciences.

Results:

Green Mountain Club caretakers and rangers were employed as volunteer observer-interviewers on Vermont's Long Trail. Four measures of observer performance were tested: (1) The number of forms completed and sampling percent; (2) missing data rates; (3) sample representativeness, and (4) interobserver reliability. Results indicate that the method is feasible and economical; however, the number of forms completed and the degree of completion varied significantly among individual observers. Observational information was collected more readily than conversational information. The potential use of observation techniques to get hiker information is discussed and research applications are suggested.

STUDY ABSTRACT

Study No. FS-NE-1903-28

Study Title: Development of Systems to Predict Trail Maintenance Costs (Trail Costs)

Study Location: Durham, New Hampshire

Schedule: Begin - September, 1976 Complete - June, 1978

Assignment: R. E. Leonard, Durham, NH

Cooperation: None

Abstract:

Problem: Can a variance in backcountry trail maintenance costs be explained mathematically by the variances in trail use levels and certain physical site characteristics? Until the relative significance of these factors on trail durability and hence trail maintenance costs are known, plans for future trail maintenance work and/or hiker capacity levels will be based on subjective estimates.

Objectives:

- (1) Determine the relative significance of variations in trail use levels and physical site characteristics to past trail maintenance efforts.
- (2) Develop mathematical relationships to predict trail maintenance costs as a function of trail use levels and key physical site characteristics.

Methods:

- (1) Literature review of previous research which has identified physical factors that affect trail durability.
- (2) Field inventory of trail maintenance work, trail use, and physical site characteristics for a selection of trails in the WMNF.
- (3) Use of factor analysis to identify groups of variables that best explain the variance in trail maintenance costs. From results of the factor analysis, develop mathematical relationship(s) to show trail maintenance costs (or time) as a function of the identified factors.

STUDY ABSTRACT

Study No. FS-NE-1903-29

Study Title: Development of System to Determine Design Capacity For Dispersed Recreation Areas (Design Capacity)

Study Location: Durham, NH

Schedule: Begin - July, 1977 Complete - May, 1980

Assignment: H. J. Plumley, Durham, NH

Cooperation: None

Abstract:

Problem: Forest managers do not have a logical system for selecting visitor capacities and management facilities for backcountry recreation areas. As more information becomes available on:

- a. the physical durabilities of different backcountry ecosystems to support recreational activities;
- b. recreationists' needs for different types of dispersed recreation opportunities, and
- c. management practices and costs to prevent or minimize physical degradation and social conflicts,

a system should be available to interrelate these factors. Site capacities could then be selected to reflect the constraints imposed by each of the three factors.

Objectives:

1. Develop the design capacity concept into a defined system for dispersed recreation planning.
2. Show how the system could be used to assist forest managers with their dispersed recreation planning decisions by preparing a case study of an existing recreation land in the Presidential Unit of the White Mountain National Forest, New Hampshire.

Methods:

1. Use methods from the planning and systems analysis disciplines to develop the procedural steps of the design capacity system.
2. Identify the types of information that will be required as "inputs" to the system and indicate how these will be used to generate information on management needs and costs to provide different types of recreational opportunities on a land area.

STUDY ABSTRACT

Study No. FS-NE-1903-30

Study Title: Design and Inventory Criteria for Backcountry Recreational Facilities (Inventory Criteria)

Study Location: New England

Schedule: Begin - July, 1977 Estimated Completion - May, 1980

Assignment: R. E. Leonard, Durham, NH

Cooperation: None

Abstract:

Problem: Detailed inventories of eastern trail and shelter systems are generally lacking. Standard approaches identifying which site factors to inventory, and how to record these conditions, have not been developed for wide application. Criteria for site selection, layout, and design of overnight facilities, have not been identified. This information is needed by the myriad groups and agencies which manage eastern trail/shelter systems.

Objectives:

1. To develop a framework for compiling field information pertinent to sound management and planning of backcountry areas.
2. To develop site identification and design guidelines for overnight recreational facilities.

Methods:

1. Survey:
 - a. Past resource inventories conducted for backcountry regions, and
 - b. existing examples of site selection, layout, and facility design.
2. Develop guidelines to inventory backcountry trail/shelter facilities. Prepare campsite design criteria using a manual format.

Results: Part of this study has been completed. Two guidelines have been prepared which indicate overnight site design and location criteria. Further study is anticipated on the determination of inventory variables and their needed levels of precision for making management decisions about an area's potential dispersed recreation capacities.

STUDY ABSTRACT

Study No. FS-NE-1903-31

Study Title: Methods to Alter Backcountry Travel Patterns
(Alter Use Patterns)

Study Location: New England

Schedule: Begin - June, 1977 Estimated Completion - Dec., 1979

Assignment: R. E. Leonard, Durham, NH

Cooperation: None

Abstract:

Problem: Altering patterns of use is a management option where the physical resource is threatened by recreational use, or where maintenance to increase land durability is either unavailable or undesirable. This option has gone largely unexploited by managers. Traditionally, permits and regulations have been the only means employed to alter use. More subtle alternatives which are effective, yet do not degrade the recreational experience, are needed.

Objective: To identify and evaluate management techniques to alter patterns of use.

Method: Observational techniques will be used to evaluate various forms of "barriers" which may be implemented to influence use patterns. Examples of barriers include written (signs, informational maps, and pamphlets), oral (hiker contacts with caretakers/rangers), and natural (low-maintenance trails, dense vegetation).

STUDY ABSTRACT

Study No. FS-NE-1903-31a

Study Title: A Study to Test the Feasibility of a Designated Dispersed Camping System in Backcountry Areas

Study Location: New England

Schedule: Begin 3/15/78 Estimated completion 3/15/80

Assignment: Dr. L. K. Canon, Dept. of Psychology
University of New Hampshire, Durham, NH 03824, and
H. E. Echelberger, USDA For. Serv., NEFES, Project NE-1903
Durham, NH 03824

Cooperation: University of New Hampshire, Dept. of Sociology,
Durham, NH 03824
Cooperative-Aid Agreement No. 23-026

Abstract:

Problem: Although dispersed camping is a recognized policy in many backcountry and wilderness areas of eastern national forests, it is not a widespread practice. The problem stems from the inability of campers to move from shelter area/tent platform camping to dispersed camping. An intermediate step needs to be developed and tested.

Objective: Determine the feasibility of a set of designated dispersed campsites as an unobtrusive behavioral change technique to encourage dispersed camping.

Method: Two sets of designated dispersed tentsites will be installed along two types of backcountry hiking trails. A designated dispersed (DD) tentsite is defined as a small clearing at the end of a 200+ foot spur trail that runs at a 90° angle from the main trail. Use of the tentsites as well as trailside sites will be monitored on 3 to 5 sites per week for 2 months. Half way through the study period brochures will be made available and small signs "announcing" the existence of the DD tentsites will be installed. Comparisons of use will be made between the two types of sites before and after initiation of the brochures and signs.

Results: Forty percent of the DD tentsite use occurred in the first 23 days of the study period, and 60 percent occurred in the last 23 days. Fifty-eight percent of the non-DD use occurred in the first 23 days, and 42 percent occurred in the last 23 days. The brochures and signs had a definite effect on the use of the two types of tentsites. DD tentsite users tended to be less experienced than non-DD tentsite users. DD tentsite use accounted for nearly half of the use recorded on the lightly used trail in the Dry River Wilderness, but only a quarter of the use recorded on the heavily used trail in the Pemigewasset Restricted Use Area.

STUDY ABSTRACT

Study No. FS-NE-1903-32

Study Title: The Effect of Hiking Traffic on Ground Vegetation and Surface Soil Conditions

Study Location: Doublehead Mountain, New Hampshire

Schedule: Begin - Spring, 1978 End - 1980

Assignment: R. E. Leonard, Durham, N. H.

Cooperation: None

Abstract:

Problem: The litter and humus layer (O horizon) of forest soil is an important protective covering for the underlying mineral soil. Removal of the O horizon by trampling exposes the mineral soil to direct abrasion and to the erosive action of rainfall and runoff. The amount of trampling the forest floor can absorb before the O horizon is disrupted is not known.

Objectives: To determine the impact of two levels of pedestrian traffic on two forest types in the White Mountains of New Hampshire.

Methods: The study will be installed on Doublehead Mountain in Jackson, New Hampshire. Two forest types will be used as study sites. One, a mixed hardwood forest (elevation 2,300 feet); the other, a spruce-fir forest (elevation 3,400 feet). Three trampling paths will be set up at each site. Two paths will be subjected to different levels of trampling and one path will serve as a control. Ten 1-meter by 1/2-meter plots will be monitored on each path using direct observation and photographic techniques. Vegetative destruction, O horizon, disruption, and soil compaction are factors under examination.